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### (54) Machine dishwashing process.

(57) A machine dishwashing process characterised in that a highly concentrated aqueous cleaning formulation is sprayed onto at least partially soiled articles and, after a contact time, the cleaning formulation and soil are removed in one or more subsequent stages is disclosed.

A dishwashing machine characterised in that it is adapted to effect such a process is also disclosed.

Improved results, for example as regards starch and stain removal, may be obtained by application of the present process.

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### "Machine dishwashing process"

This invention relates to a machine dishwashing process; more particularly, it relates to an improvement in continuous or non-continuous machine dishwashing, whether conducted using a single tank, multitan or conveyor type machine.

In a typical machine dishwashing process, tableware or cookware, such as dishes soiled with food remains, trays, cutlery and lipstick-smeared glasses, is intensively sprayed with water in a prewash zone or prewash cycle. The water used for the prewash may be cold or preheated fresh water or cooling water from a vapour condensation process, but is generally overflow water of a wash liquor, which is generally sprayed onto the articles under relatively low pressure and in relatively large amounts using suitably located spray nozzles. After this prewash zone or prewash cycle, the articles enter the actual wash zone or wash cycle, where they are again vigorously sprayed this time with a wash liquor.

The wash liquor is generally water at a temperature of from 50 to 60°C to which a liquid or powder-form detergent is added. In order to remove grease, starch, stains and protein with sufficient reliability, for example powder detergent or liquid detergent is added to water to provide from 0.1 to 0.3 weight percent of active cleaning agent in solution. This resulting wash liquor is sprayed onto the articles by pump means through lower and upper nozzles and, in some cases, through additional lateral nozzles. The soil present on the articles is removed or at least swollen or softened and partially dissolved by the wash liquor. In following rinse zones or cycles, the swollen or softened food remains are removed and, at the same time, the wash liquor is rinsed off by water. In a final rinse zone or final rinse cycle, any residues of the wash liquor are removed by water at a temperature of up to about 85°C. The final-rinse water consists of fresh water with an added rinse aid, which ensures that only an ultrathin film of water remains on the articles, which can evaporate in a following drying zone.

Even the use of relatively large amounts of detergent in regular conventional cleaning will not always avoid the need for periodic heavy-duty cleaning. The object of this extra cleaning is to remove coatings of, for example water-insoluble stains or starch which have gradually built up, but which are not immediately discernible. For this heavy-duty cleaning, the articles are treated occasionally with a wash liquor containing several times the normal quantity of detergent. Optionally, a manual pre-soak may be employed to the same end. Both of these methods also mean additional pollu-

tion of the wastewater.

An object of the present invention is to provide surprisingly advantageous dishwashing. The improved efficiency of cleaning obtainable may reduce labour, water and chemical consumption, hence lower pollution and rejects, while ensuring satisfactory cleaning even in adverse conditions.

The present invention provides a machine dishwashing process characterised in that a highly concentrated aqueous cleaning formulation is sprayed onto at least partially soiled articles and, after a contact time, the cleaning formulation and soil are removed in one or more subsequent stages.

The present invention also provides a dishwashing machine adapted to effect such a process, for example by addition of extra spray nozzles and associated systems and/or by modifications to the control systems of the machine.

The aqueous cleaning formulation may be derived from powder-form or liquid materials. Generally, the sprayed cleaning formulation comprises at least 0.5 weight percent of one or more active cleaning agents. While, say, 30 weight percent might be regarded as an upper limit, the critical factor is that the formulation must remain sprayable. Preferably, the sprayed cleaning formulation comprises from 0.8 to 10 weight percent, more preferably from 0.9 to 3 weight percent, of one or more active cleaning agents.

Generally, a contact time of at least 2 seconds will be sufficient for the desired chemical, as opposed to mechanical, action. In preferred embodiments, this may be from 5 to 100 seconds, in particular from 8 to 25 seconds. So as to provide the desired prolonged intimate contact or "saturation", the "mechanical effect" of spraying is at least minimised, if not avoided. During this contact time, the articles being washed are not deliberately sprayed.

In order to optimise results, it is important that substantially the whole surface of a soiled article should be contacted by the sprayed cleaning formulation and the amount of formulation sprayed and the manner in which it is sprayed may be adapted bearing this aim in mind. A fine, gentle mist-like spray is particularly desirable. In a conveyor-type machine, the belt speed will also be a factor. More particularly, the volume sprayed and/or the number and/or arrangement of spray nozzles is/are selected so that low volume spraying will ensure the desired type of complete coverage and even distribution. The nature, volume and concentration of the sprayed formulation may be varied, as may the spray means, depending, for example, on the load and, where appropriate, the

motion and/or speed of the conveyor. The present low volume/low intensity mist-like application of concentrated cleaning formulation is in contrast to the vigorous high volume spraying used in conventional dishwashing.

Generally, a machine dishwashing process may comprise one or more prewash cycles or zones, which may be optional, for example to remove heavy soil, one or more wash zones and one or more rinse zones. In accordance with the present invention, the unusually high concentration cleaning solution is sprayed somewhere prior to the final rinse, commonly as at least part of a wash cycle or in a wash zone.

While all of the cleaning agents required may be included in the sprayed concentrate, it may be advantageous to introduce additional cleaning formulation in a conventional manner at some stage of the process. This further material is generally not the same as the sprayed concentrate, but may merely be the same composition further diluted. The use of a complementary formulation particularly commends itself. The balance of the complementary products may also be adjusted. For example, a high alkalinity spray might be balanced by a lower alkalinity wash to follow. The present system also enables chemicals which would normally be incompatible when mixed in a single product to be used in conjunction, for example oxidising agents, such as hypochlorite, may be used in the spray with, for example, water conditioning agents, such as NTA (nitrilotriacetate) being introduced later.

While the concentrated cleaning formulation is generally sprayed more or less throughout the appropriate part of the dishwashing process, it may be used intermittently or occasionally, for example during the wash cycle in a non-conveyor type machine.

The aqueous cleaning formulation sprayed must be flowable, but may be in the form of a solution, emulsion or slurry, for example. Various materials are known which will cause or facilitate at least some penetration and/or swelling and/or loosening and/or dissolution of soil. Typically, a basic cleaning formulation will comprise a source of alkalinity and a source of sequestering activity. Such formulations may be adapted to combat particular problems. For example, tea-stain removal might suggest the inclusion of bleaching agents, while products based on amylase may be useful for starch removal without alkalinity.

For purposes of illustration, a machine for carrying out the present process may be a conveyor transport machine and may comprise a prewash zone, a wash zone, a rinse zone, a final rinse zone and a drying zone. Fresh water is only supplied to the final-rinse zone, subsequently passing cascade-

fashion towards the prewash zone in countercurrent to the direction of transport of the dishes.

A simple product fairly efficient in removing built-up starch residues and stains may be formulated from the following :

Potassium hydroxide 20 - 30 wt %  
Chelating agent(s) 15 - 25 wt %  
Threshold agent(s) 2 - 4 wt %  
Dispersing polymer(s) 2 - 4 wt %  
Wetting agent(s) 1 - 2 wt %  
Balance water

Optimisation of such a product is possible and desirable. Such a product may be blended with water in-line before being sprayed at a dilution of about 2.5 % through suitable spray nozzles situated within the wash zone immediately before or after the conventional wash zone. Sprayed ware may then pass through part of the wash zone with the pumps turned off (unless there is already sufficient separation between zones) so as to allow a contact time of about 15 seconds, before reaching a further wash or rinse zone. Further detergent may be added by conventional means at other stages to provide additional destaining and prevention of incrustation of machine parts. Thereafter, the ware passes to a final rinse stage where rinse aid may be introduced.

After soiled dishes have been loaded onto the conveyor belt, in the prewash zone it is deluged in overflow water from the wash zone, which has a temperature of about 40°C. All coarse or relatively large quantities of food remains are thus removed from the dishes. The dishes then enter the actual wash zone. In the wash zone, the dishes are sprayed with the highly concentrated detergent solution, each nozzle may be delivering as little as 6 l/hour and typically there will be from 3 to 10 nozzles. The system is arranged or adapted to ensure that nothing disturbs the desired prolonged intimate contact.

The speed of the conveyor belt is advantageously selected so that the contact time of the detergent solution, depending on its concentration, is from 5 to 100 seconds, generally about 10 seconds. Such a contact time and the high concentration of the detergent solution ensure that all food remains on the dishes, especially grease (fats), starch, stains and protein, are completely removed and bacteria destroyed.

After this contact time, the detached food remains, together with the detergent solution sprayed on, are washed off by the subsequent stages using conventional spray nozzles, the wash liquor consisting of overflow water from the rinse zone and of rinsed-off, concentrated detergent solution and any additional dosed complementary cleaning formulation. With the process according to the present invention, there is no longer any need for the

intermittent heavy-duty cleaning or the manual pre-soak hitherto necessary.

In the subsequent rinse zone, any loosened food and soil remains still present on the dishes and residues of the wash liquor are rinsed off with clear water at a temperature of about 70°C. In the final-rinse zone, fresh water at a temperature of about 85°C with rinse aid added ensures that only a thin film of water remains on the dishes, which dries rapidly in the following drying zone either through the heat of the dishes or by introduction of hot air.

By virtue of the present process, dishes are reliably maintained to a consistent high standard of cleanliness.

### Claims

1. A machine dishwashing process characterised in that a highly concentrated aqueous cleaning formulation is sprayed onto at least partially soiled articles and, after a contact time, the cleaning formulation and soil are removed in one or more subsequent stages.

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2. A process as claimed in claim 1 wherein the sprayed cleaning formulation comprises at least 0.5 weight percent, more preferably from 0.8 to 10 weight percent, most preferably from 0.9 to 3 weight percent, of one or more active cleaning agents.

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3. A process as claimed in claim 1 or claim 2 wherein the contact time is at least 2 seconds, more preferably from 5 to 100 seconds, most preferably from 8 to 25 seconds.

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4. A process as claimed in any of claims 1 to 3 wherein the cleaning formulation is sprayed in such an amount and in such a manner as to contact substantially the whole of the surfaces of the soiled articles.

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5. A process as claimed in claim 4 wherein the volume of cleaning formulation sprayed and/or the number and/or arrangement of spray nozzles is/are such that low volume spraying will provide substantially complete contact and substantially even distribution.

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6. A process as claimed in any of claims 1 to 5 wherein, in a conveyor-type machine, the speed and/or motion of the conveyor belt and/or the load is/are such that low volume spraying will provide substantially complete contact and substantially even distribution.

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7. A process as claimed in any of claims 1 to 6 wherein there are one or more optional prewash cycles or zones; one or more wash cycles or zones and one or more rinse cycles or zones, the cleaning formulation being sprayed prior to the final rinse cycle or zone.

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8. A process as claimed in claim 7 wherein a wash cycle or zone comprises the spraying of the cleaning formulation.

9. A process as claimed in any of claims 1 to 8 wherein further, preferably non-identical, cleaning formulation is introduced in a conventional manner.

10. A process as claimed in claim 9 wherein the cleaning formulations are complementary.

11. A process as claimed in any of claims 1 to 10 wherein the cleaning formulation is sprayed for substantially the whole duration of the dishwashing or for one or more discrete portions thereof.

12. A dishwashing machine characterised in that it is adapted to effect a process as claimed in any of claims 1 to 11.

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	FR-A-2 086 019 (PHILCO-FORD CORP.) * Claims *	1-2	A 47 L 15/00
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X	DE-A-3 330 537 (BOSCH-SIEMENS) * Claims 1-2 *	1-2	
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X	GB-A-1 099 701 (GOULDING) * Page 2, lines 38-50; page 2, lines 83-87; claims 2,11,12,17 *	1-2	
A	---	8-9	
Y	EP-A-0 040 006 (WATSON) * Page 15, line 9 - page 17, line 11; claims 20-23 *	1-2	
A	---	4-5,7,8 ,11	
Y	FR-A-2 125 396 (HENKEL) * Page 3, line 25 - page 4, line 10 *	1-2	
A	GB-A-1 021 051 (HOOVER LTD) * Page 1, line 78 - page 2, line 1; claims 1-4,13-17,21-24 *	2,4,8- 11	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	US-A-3 043 724 (BALSHAW) * Column 6, line 3 - column 8, line 2 *	1,3,7	A 47 L
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The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
THE HAGUE	15-06-1988	GAIC P.M.Z.	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone	T : theory or principle underlying the invention		
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EUROPEAN SEARCH REPORT

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)									
A	FR-A-2 090 151 (AVANT INDUSTRIES INC.) * Page 8, lines 2-24 * ---	5-6										
A	FR-A-2 574 645 (ESSWEIN) * Whole document * ---	;										
A	EP-A-0 036 217 (STIERLEN-MAQUET AG) * Page 6, lines 2-26 * ---	4-6										
A	FR-A-1 386 199 (LYONS & CO., LTD) * Page 2, left-hand column, lines 2-10; page 2, right-hand column, lines 5-11 * ---	6										
A	FR-A-2 169 695 (HILDEBRAND ING. AG) * Page 1, lines 1-15; page 9, line 18 - page 11, line 10; claims 1,12 * ---	7-11										
A	DE-A-1 703 441 (ROBERT BOSCH) * Claim * ---	9-10										
A	US-A-3 645 421 (TUTHILL) * Column 1, line 67 - column 2, line 27; claims 1,3,4-7 * ---	9-10	TECHNICAL FIELDS SEARCHED (Int. Cl. 4)									
A	FR-A-2 589 057 (LICENTIA PATENT-VERWALTUNGS GmbH) * Claim 1 * ---	11										
A	FR-A-2 275 116 (LICENTIA PATENT-VERWALTUNGS GmbH) * Whole document * ---	11										
A	US-A-3 549 294 (KERR et al.) * Whole document * -----	1,3										
<p>The present search report has been drawn up for all claims</p> <table border="1"> <tr> <td>Place of search <b>THE HAGUE</b></td> <td>Date of completion of the search <b>15-06-1988</b></td> <td>Examiner <b>GAIC P.M.Z.</b></td> </tr> <tr> <td colspan="3"> <b>CATEGORY OF CITED DOCUMENTS</b>            X : particularly relevant if taken alone            Y : particularly relevant if combined with another document of the same category            A : technological background            O : non-written disclosure            P : intermediate document         </td> </tr> <tr> <td colspan="3">           T : theory or principle underlying the invention            E : earlier patent document, but published on, or after the filing date            D : document cited in the application            L : document cited for other reasons            &amp; : member of the same patent family, corresponding document         </td> </tr> </table>				Place of search <b>THE HAGUE</b>	Date of completion of the search <b>15-06-1988</b>	Examiner <b>GAIC P.M.Z.</b>	<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		
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